MULTIPLE GLAZING ELEMENT WITH SOUND AND HEAT INSULATION PROPERTIES

The present invention concerns a multiple glazing element for sound protection mounted in a window comprising a first laminated glass pane and at least one second single thickness glass pane, parallel to the first pane and separated from the latter by a layer of gas, the glass sheets of the laminated pane being joined together by at least one plastic film. Such glazing elements are usually intended to be installed in buildings in order to reduce on the inside the perception of outside noises and to provide heat protection.

For several years, in many countries, the use of heat insulating glazing elements has become widespread. Most frequently, they consist of two panes of the same thickness, usually lying between 2.5 and 4 mm, separated by a 6 to 16 mm layer of gas and bonded on their periphery with the aid of varied mastics and where appropriate metal sections. During the heating period, such glazing elements improve the comfort of premises used for habitation, work and leisure and significantly reduce the heat losses. With respect to the sound insulation, a glazing element comprising a 4 mm pane, a 12 mm gas layer and a 10 mm pane constitutes an appropriate benchmark.

In order to satisfy certain heat or sound insulation requirements, other types of glazing elements have already been proposed that are multiple and laminated glazing elements. However, the latter pose problems of weight and volume in relation to the windows into which they are built. In particular, such glazing elements are produced with single thickness glass panes that are usually thicker than 8 mm and usually used laminated glass panes that generally consist of glass sheets at least 4 mm thick. This also produces multiple glazing

elements that are extremely bulky and heavier than average and in particular heavier than a benchmark insulating glazing element such as is cited hereinabove.

The invention therefore aims to supply a glazing element to provide heat and sound protection as effective as a benchmark insulating glazing element or as a multiple and laminated glazing element, without being so heavy.

The multiple glazing element according to the invention is characterized in that the two glass sheets of the laminated glass pane each have a thickness lying between 1.5 and 2.5 mm and the single thickness glass pane has a thickness lying between 3 and 5 mm, and that the weight of the glazing element is at least 30% less than the weight of an insulating glazing element which comprises at least two sheets of single thickness glass separated by a layer of gas having the same thickness as that of the multiple glazing element, the difference between the weighted sound reduction index R_w of the multiple glazing element and the weighted sound reduction index R_w of said insulating glazing element with two sheets of single thickness glass not exceeding 3 dB.

It shall be noted that throughout the description, the numeric values given for the glass thicknesses are considered with a 5% degree of uncertainty.

Preferably, the weight of the multiple glazing element is at least 40% less than the weight of the insulating glazing element with two sheets of single thickness glass.

Advantageously, the difference between the weighted sound reduction index R_w of the multiple glazing element and the weighted sound reduction index R_w of

said insulating glazing element with two sheets of single thickness glass does not exceed 2 dB, the indices possibly even being equivalent.

According to one feature, the layers of gas have a thickness lying between 6 and 20 mm and preferably of 12 mm.

According to another feature, the plastic film of the laminated glass pane has a thickness equal to or greater than 0.38 mm.

Advantageously, this plastic film is a film giving improved sound insulation properties.

A film with improved sound insulation properties is called a film fulfilling the criteria as defined in patents EP-B1-0 100 701 or EP-B1-0 844 075, in particular to provide good sound protection against road or solid-borne noises.

In patent EP-B1-0 100 701, the film is selected such that a strip 9 cm long and 3 cm wide, consisting of a laminated glass pane comprising two glass sheets 4 mm thick joined together by a 2 mm layer of this film, has a critical frequency that differs not more than 35% from that of a strip of glass having the same length, the same width and being 4 mm thick.

In patent EP-B1-0 844 075, the film insert is adopted when it has a $\tan\delta$ loss factor greater than 0.6 and a G' shear modulus less than 2.10^7 N/cm^2, in a temperature range of between 10 and 60°C, in a frequency range between 50 and 10 000 Hz.

Or, it will be preferable, in order to choose a film with improved sound insulation properties, to apply the selection criteria of patent EP-B1-0 387 148, when it is preferred to provide protection against aerodynamic

noises. This European patent proposes using a laminated glazing element whose insert has $\nu = \Delta f/f_c$ flexion damping greater than 0.15, the measurement being taken while exciting by an impact, a strip 9 cm long and 3 cm wide made of a laminated glass in which the resin is between two panes each 4 mm thick, and while measuring the resonance frequency of the first mode f_c and the width of the peak Δf at an amplitude of $A/\sqrt{2}$ where A is the maximum amplitude at frequency f_c such that its sound reduction index differs for none of the frequencies greater than 800 hertz by more than 5 decibels from a benchmark index increasing by 9 dB per octave up to 2000 Hz and by 3 dB per octave at the higher frequencies.

According to another feature of the invention, the plastic film is associated with at least one other film providing in particular properties additional to those providing the laminating.

Advantageously, at least one of the glass sheets of the glazing element comprises at least one functional coating.

According to one embodiment of the glazing element, it comprises a single thickness glass pane 3 mm thick, and a laminated glass pane with two glass sheets each 2.1 mm thick.

According to a second embodiment of the glazing element, it comprises a single thickness glass pane 4 mm thick, and a laminated glass pane with two glass sheets each 1.6 mm thick.

According to a third embodiment of the glazing element, it comprises a single thickness glass pane 4 mm thick, and a laminated glass pane with two glass sheets each 2.1 mm thick.

In general, the glazing elements according to the invention have dimensions of less than 2 m^2 and are intended to be installed in buildings or vehicles, such as motor vehicle glazing elements.

Other advantages and features of the invention will now be described in greater detail with reference to the appended drawings in which:

- figure 1 represents a multiple glazing element according to the invention;
- figure 2 illustrates the sound reduction index of different glazing elements of the invention and of a benchmark insulating glazing element.

The multiple glazing element 1 illustrated in figure 1 comprises a laminated glass pane 10 and a single thickness glass pane 20, these panes being separated by a layer of gas 30 such as a layer of air, and assembled in a sealed manner by means known to those skilled in the art.

The single thickness glass pane 20 has a thickness lying between 3 and 5 mm.

The laminated glass pane consists of at least two glass sheets 11 and 12 separated and secured to one another by a sheet of plastic material 13.

Each glass sheet has a thickness lying between 1.5 and 2.5 mm.

The sheet 13 is at least 0.38 mm thick. This sheet is for example made of polyvinylbutyral (PVB) with improved sound insulation properties, or of normal PVB which does not have such sound insulation properties.

Naturally, the glazing element may comprise, on one or more of its constituent glass sheets, functional

coatings of the thin layer type, for example, for anti-scratch protection, protection against UV rays, glazing element coloration. In addition, the plastic film 13 may be associated with at least one other film providing in particular additional properties (colors, anti-UV, light diffusion, etc.).

The glazing element of the invention has sound insulation properties equivalent or substantially equivalent, that is to say not exceeding a difference of 1 dB in sound reduction index, to a usual benchmark insulating glazing element which comprises at least two glass sheets separated by a layer of gas identical to the layer of gas 30, the weight of the glazing element of the invention being at least 30% less than the weight of the benchmark insulating glazing element, preferably at least 40% less. It will be noted that the weight of the insert is considered negligible.

Benchmark insulating glazing element No.0 is a type 4 (12) 10 glazing element, that is to say comprising a 4 mm glass sheet, a 12 mm gas layer and a 10 mm glass sheet.

This benchmark glazing element is particularly effective because it has a weighted sound reduction index R_w of 38 dB, compared with an insulating glazing element of the same constitution but with 3 mm glass sheets and a gas layer of identical thickness, for which the reduction index R_w is only 32 dB.

It should be remembered that the sound reduction index is measured according to the ISO 140 standard in an installation complying with said standard on glazing element samples with dimensions of 800 mm x 500 mm, and the weighted index R_w subsequently calculated according to the ISO 717 standard.

Examples of glazing elements of the invention are as follows:

- Glazing element No.1 is type 3 (12) 2.1-2.1: it comprises one 3 mm glass sheet 20, one 12 mm gas layer 30, two glass sheets 11 and 12 of laminate each 2.1 mm thick separated by a sheet of PVB with improved sound insulation properties 0.38 mm thick.

In the rest of the description, the glazing elements of the invention are numbered in this manner, the PVB sheet separating the laminate being 0.38 mm thick.

- Glazing element No.2 is of type 4 (12) 1.6-1.6 with PVB with improved sound insulation properties.

- Glazing element No.3 is of type 4 (12) 2.1-2.1 with PVB with improved sound insulation properties.

- Glazing element No.4 is of type 4 (12) 2.1-2.1 with normal PVB.

- Glazing element No.5 is of type 3 (12) 1.6-1.6 with PVB with improved sound insulation properties.

The table below gives at 21°C the sound reduction indices over the frequency range from 100 to 5000 Hz of glazing elements No.0 to No.5.

Also given at the bottom of the table, according to the ISO 717-1 standard, are the weighted reduction index R_w and the two adaptation terms C and C_{tr}.

Frequency (Hz)	Glazing element No.0 (dB)	Glazing element No. 1 (dB)	Glazing element No. 2 (dB)	Glazing element No. 3 (dB)	Glazing element No. 4 (dB)	Glazing element No. 5 (dB)
100	20.4	19.0	19.7	18.8	18.9	19.0
125	18.0	18.0	18.8	17.6	17.9	17.9
160	19.5	20.3	20.7	19.8	20.4	20.7
200	28.9	23.2	24.8	25.6	27.4	23.5
250	35.3	29.0	27.3	28.2	23.7	28.0
315	36.1	31.2	32.3	33.8	32.4	28.3
400	35.7	31.0	32.8	33.9	32.6	28.4
500	35.7	32.5	33.0	34.3	32.1	30.4
630	37.6	36.3	38.0	38.9	37.1	35.5
800	38.6	39.6	39.3	40.0	36.9	38.8
1000	38.1	40.5	41.7	42.3	39.9	40.3
1250	39.5	42.4	43.1	43.7	41.3	42.3
1600	39.1	44.5	44.1	44.8	41.6	44.2
2000	41.2	45.7	44.5	42.2	42.2	45.7
2500	41.6	46.2	43.6	44.2	40.5	46.4
3150	40.6	45.1	42.9	43.2	37.5	45.6
4000	42.2	42.6	44.4	42.5	38.2	43.5
5000	44.0	42.7	43.7	42.6	41.6	43.0
$R_w(C;C_{tr})$	38 (-2;-6)	37 (-1;-6)	38 (-2;-6)	38 (-2;-6)	37 (-2;-6)	36 (-1;-5)

The curves in figure 2 reproduce the sound reduction index measurement points from 100 to 5000 Hz in the table above. It will be noted that the glazing elements of the invention have an sound insulation behavior every bit as effective as the benchmark insulating glazing element.

The table below summarizes, for each of glazing elements No.1 to No.5 and for the benchmark glazing element No.0, the values of the weighted sound reduction index and the percentage weight reduction of the glazing elements of the invention compared with the benchmark glazing element.

Glazing element	Reduction index R_w (dB)	Weight reduction in %
No.0	38	-
No.1	37	48.6%
No.2	38	48.6%
No.3	38	41.4%
No.4	37	41.4%
No.5	36	55.7%

It can be seen that by reducing the weight of the glazing element by more than 30%, even by at least 40%, relative to the weight of a usual benchmark insulating glazing element, a fully comparable sound reduction index is obtained. Glazing elements of the No.2 or No.3 type comprising the single thickness 4 mm glass pane and including the PVB with improved sound insulation properties may be preferred.

Furthermore, the thicknesses of the glass of the single thickness glass pane (from 3 to 5 mm) and of the laminated glass pane (from twice 1.5 mm to twice 2.5 mm) are such that the greatest ratio of the extremes equals 1.7 (that is 5/(2x1.5) or (2x2.5)/3). Consequently, the imbalance in weight on one side of the glazing element relative to the other side does not exceed a factor of 2, whereas for example the benchmark glazing element has an imbalance ratio of 2.5 (10/4). Also, assembly of the single thickness glass pane to the laminated glass pane is more convenient; there is no need to position the heavier pane underneath and wait until all the seals providing leaktightness and the mechanical rigidity is finished before carrying out installation. In addition, the glazing element is easier to handle.